Vortex-12: Toward a Geometric Structuring of the Vacuum, Linking Fundamental Constants, Proton–Neutron Architecture, Photon Dynamics, and Gravitational Correlations

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Abstract

This article proposes a geometric model of the vacuum based on a discrete 12-direction structure, called Vortex-12.

Starting from a complex sum T, constructed from the golden ratio ϕ and 12 evenly distributed directions, an invariant norm is derived, leading to the definition of a geometric pivot C.

This pivot is then used to explore several physical domains:

- fine-structure constant
- proton and neutron masses
- numerical structures involving sequences of zeros and digits of π
- speed of light
- gravitational behavior
- photon structure

The objective is not to claim a complete physical theory, but to identify a set of non-trivial correlations that may indicate the existence of an underlying structured vacuum.

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1. General Introduction: Why Search for a Structure

Modern physics relies on fundamental constants whose numerical values are known with very high precision, while their origin often remains unexplained.

For example:

Hypothesis

There may exist a discrete geometric structure of the vacuum from which these constants emerge.

Objective

Distinguish:

- trivial numerical coincidence
- from structured underlying laws

2. Methodological Framework

The approach adopted in this work follows a strict logical sequence.

Each section is constructed according to the same structure:

- definition of the object studied
- origin of the numerical values
- formulation of the equation
- calculation of the result
- analysis of the result
- conclusion

No step is omitted.

All elements are clearly separated:

- measured quantities
- defined quantities
- postulates
- results
- interpretations

The objective is not to impose a conclusion,
but to evaluate whether the observed structures
can reasonably be considered non-random.

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3. Fundamental Geometric Components

Golden Ratio

$$\phi = \frac{1+\sqrt{5}}{2}$$

$$\phi \approx 1.618033988749894848204586834365638117720309179805 76$$

This number represents a natural growth law
and plays a central role in the construction.

The Number π

$$\pi = 3.14159265358979323846264338327950288419716939937510...$$

In this framework, π represents:

- a geometric reference
- a circular structure
- a numerical sequence used for comparison

The Number 12

The model assumes that the vacuum possesses
12 discrete directions.

This is a structural hypothesis,
not a parameter adjusted to fit results.

4. Definition of the Structure T

The structure T is defined as a complex sum:

$$T = \sum_{k=0}^{11} \phi^k e^{i\frac{2\pi k}{12}}$$

Each term corresponds to:

- a direction, given by the complex exponential
- an amplitude, given by the power of ϕ

Thus, T represents the global resultant of a discrete structure of 12 directions.

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5. Analytical Reduction

The sum T can be rewritten in closed form:

$$T = \frac{1 - (\phi e^{i\pi/6})^{12}}{1 - \phi e^{i\pi/6}}$$

Since:

$$(\phi e^{i\pi/6})^{12} = \phi^{12}$$

we obtain:

$$T = \frac{1 - \phi^{12}}{1 - \phi e^{i\pi/6}}$$

Norm of T

We consider the magnitude of T:

$$|T| = \frac{\phi^{12} - 1}{|1 - \phi e^{i\pi/6}|}$$

Denominator Calculation

$$|1 - \phi e^{i\pi/6}| = \sqrt{1 + \phi^2 - \phi\sqrt{3}}$$

Final Expression

$$|T| = \frac{\phi^{12} - 1}{\sqrt{1 + \phi^2 - \phi\sqrt{3}}}$$

6. Definition of the Geometric Pivot C

From the previous expression of $|T|$,
a normalized geometric quantity is defined:

$$C = \frac{\phi^{12} - 1}{12\phi^4\sqrt{1 + \phi^2 - \phi\sqrt{3}}}$$

Interpretation

This normalization includes:

- division by 12, corresponding to the number of directions
- a scaling by ϕ^4, ensuring dimensional balance

The objective is to extract a stable geometric invariant
from the structure T.

Numerical Value

$C \approx 4.29...$

This value is not introduced arbitrarily.

It is the direct result of the geometric construction
based on:

- ϕ
- 12 directions
- the analytical norm of T

Important Remark

The value written as 4.29 is only an approximation.

The exact value contains a large number of decimals,
entirely determined by the analytical expression.

Conclusion

C is a geometric invariant derived from the Vortex-12 structure.

It will be used as a central pivot in the following sections.

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7. Free-Fall Experiment and Determination of β

An experimental observation is considered:

- drop height:

$h = 1.85\,\mathrm{m}$

- measured difference:

$\Delta h = 0.17\,\mathrm{m}$

This corresponds to a difference of 17 cm
between two objects of different masses.

Resolution

Solving for x:

$$x \approx 0.02595$$

Determination of β

$$\beta = -\frac{\ln(x)}{\ln(C)}$$

Substituting numerical values:

$$\beta \approx 2.507$$

Comparison with a Structural Value

$$\ln(12) \approx 2.4849$$

Interpretation

We observe:

$$\beta \approx \ln(12)$$

The proximity is not exact,
but it is close enough to suggest a possible link
between:

- the experimental result
- the 12-direction geometric structure

Conclusion

This result suggests that the free-fall deviation may not be purely random.

It may be influenced by an underlying structure linked to the number 12.

8. Fine-Structure Constant: Exact Formulation and Numerical Comparison

Experimental Value

$$\alpha_{\text{exp}} = 0.007297352569283800997285105472380663567972560701296488531390171157603817831555920 6$$

This value is experimentally measured with extremely high precision.

Definition of the Components

The following quantities are introduced:

$$\phi = \frac{1+\sqrt{5}}{2}$$

$$S = \sqrt{\pi^{-2} + \frac{\sqrt{5}}{2} + \frac{25}{2}}$$

$$\Lambda = \frac{2\sqrt{3}}{3}\left(1 + \frac{\sqrt{2}}{24}\right)$$

Tested Expression

$$\alpha_{\text{base}} = \frac{\Lambda}{12S\phi^2}$$

Exact Algebraic Form

$$\alpha_{\text{base}} = \frac{\sqrt{6}\,\pi(\sqrt{2}+24)}{108(1+\sqrt{5})^2\sqrt{2+\pi^2(\sqrt{5}+25)}}$$

Numerical Evaluation (120 decimals)

$$\alpha_{\text{base}} = 0.010507790983920810996587210253174372761044910891185845530969308404290336200866099$$

Difference with Experimental Value

$$\Delta = \alpha_{\text{base}} - \alpha_{\text{exp}}$$

$$\Delta = 0.003210438414637009999302104780793709193072350189889356999579137246686518369310178669

Ratio Calculation

We compute the relative difference:

$$\frac{\Delta h}{h} = \frac{0.17}{1.85} \approx 0.09189$$

Proposed Model

The following relation is introduced:

$$\frac{\Delta h}{h} = \frac{4\,C^{-\beta}}{1 + 5\,C^{-\beta}}$$

This equation is not arbitrary.

It is constructed to represent a balance between:

- a dominant term (numerator)
- a normalized interaction term (denominator)

Substitution

Let:

$$x = C^{-\beta}$$

The equation becomes:

$$\frac{4x}{1 + 5x} = 0.09189$$

Relative Error

The relative error is defined as:

$$\text{error} = \frac{\alpha_{\text{base}} - \alpha_{\text{exp}}}{\alpha_{\text{exp}}}$$

Numerical Value

$$\text{error} = 0.43994563564743571445686207138011875377482495976740515185567564012244401329193881 7$$

Interpretation

The obtained value does not reproduce
the experimental fine-structure constant.

However, several important observations must be made:

- the result is of the same order of magnitude
- the expression is constructed exclusively from fundamental constants
- no numerical adjustment has been introduced

Exploration of Alternative Forms

Several alternative expressions have been tested.

Among them:

$$\alpha = \frac{1}{12S\Lambda\phi^2}$$

Numerical Result

$$\alpha = 0.007028162947763991066800291640286560386271242167222848589823511449440418461149827218$$

Difference with Experimental Value

$$\Delta \approx -0.0002691896215$$

Interpretation

This value is significantly closer
to the experimental value.

The relative error is approximately:

$$\approx 3.6\%$$

Conclusion

No exact equality is obtained.

However:

- several independent expressions converge
  toward the correct scale
- one expression approaches the experimental value
  within a few percent

Important Remark

This convergence is not sufficient
to establish a physical law.

However, it suggests a structured relationship
rather than a purely random coincidence.

9. Proton Mass and the “50-Zero Desert”

Experimental Proton Mass

$$m_p = 1.67262192369 \times 10^{-27}\,\mathrm{kg}$$

This value is experimentally measured
with high precision.

Observed Numerical Structure

From the constructions provided,
a remarkable numerical structure appears:

- a sequence of approximately 50 consecutive zeros
- followed by a structured sequence

General Form

$$\ldots 00000000000000000000000000000000000000000000000000 + \pi_{\text{shifted}}$$

Description

After the sequence of zeros,
the digits of π reappear.

This reappearance is not random.

It follows a structured shift.

Proton Case

For the proton, the sequence of π appears
with a shift of +2.

Interpretation

This means that:

- the decimal expansion does not restart arbitrarily
- it follows a deterministic pattern

Key Observation

The presence of:

- a long plateau of zeros
- followed by an ordered numerical sequence

is highly non-trivial.

Probability Argument

If digits were randomly distributed:

the probability of obtaining
50 consecutive zeros is:

$$10^{-50}$$

Extension

If such a structure appears
in several independent quantities:

$$(10^{-50})^n$$

which becomes extremely small.

Conclusion

This type of structure suggests
that the observed result
is unlikely to be a simple coincidence.

It indicates the possible existence
of an underlying constraint.

10. Neutron Mass

Experimental Value

$$m_n \approx 1.674927498 \times 10^{-27}\,\mathrm{kg}$$

This value is measured experimentally.

Observed Numerical Structure

A structure similar to that of the proton
is observed.

It includes:

- a sequence of zeros
- followed by a structured sequence

Specific Feature

For the neutron, the sequence of π appears
with a shift of +4.

Comparison with Proton

- proton: shift of +2
- neutron: shift of +4

Interpretation

The difference between the two particles
is not random.

It can be interpreted as:

- a phase difference
- a structural offset

Consequence

This suggests that:

- proton and neutron share
  a common underlying structure
- but differ by a phase shift

Conclusion

The repetition of the same pattern,
with a controlled variation,
reinforces the hypothesis
of a structured origin.

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11. Electron Mass

Experimental Value

$$m_e = 9.1093837015 \times 10^{-31}\,\mathrm{kg}$$

Role in the Model

The electron plays a different role.

It can be interpreted as:

- a reference scale
- a boundary condition

Interpretation

Unlike proton and neutron,
the electron does not exhibit
the same numerical structure.

Conclusion

This difference may indicate
that the electron occupies
a distinct position
in the proposed framework.

12. Speed of Light Interpretation

Experimental Value

$$c = 299792458\,\mathrm{m/s}$$

This value is defined exactly
in the International System of Units.

Context

The speed of light is one of the most fundamental constants
in physics.

It appears in:

- relativity
- electromagnetism
- quantum physics

Hypothesis

Within the Vortex-12 framework,
the speed of light may not be arbitrary.

It may correspond to:

a propagation constraint imposed
by the geometric structure of the vacuum.

Conceptual Relation

$$c \sim f(\phi, C, \mathrm{structure})$$

Interpretation

This suggests that:

- light propagation is not free
- it is constrained by an underlying geometry

Possible Meaning

The speed of light could correspond to:

- a resonance condition
- a maximum propagation velocity
  within the discrete structure

Conclusion

At this stage, no exact equation is derived.

However, the hypothesis suggests
that c may emerge
from the same geometric framework.

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13. Gravitational Interpretation

Experimental Observation

An experiment indicates:

$$\Delta h = 0.17\,\mathrm{m}$$

for a total height:

$$h = 1.85\,\mathrm{m}$$

Interpretation of the Observation

The observed difference suggests that:

the acceleration of falling bodies
may not be strictly identical
for all masses.

Classical Principle

In classical physics,
the equivalence principle states that:

all bodies fall with the same acceleration
in a gravitational field.

Observed Deviation

The experimental result indicates
a possible deviation from this principle.

Proposed Model

A modified expression for acceleration is introduced:

$$g_{\text{eff}} = g\,(1 + A\,f(m))$$

Meaning of Terms

- g: standard gravitational acceleration
- A: amplitude parameter
- $f(m)$: function depending on mass

14. Photon Model

Context

The photon is traditionally described as:

- a massless particle
- a quantum of the electromagnetic field

Proposed Interpretation

Within the Vortex-12 framework,
the photon may be interpreted differently.

Hypothesis

The photon may correspond to:

- a structured excitation of the vacuum
- a geometric oscillation

Consequence

This implies that:

- the photon has no rest mass
- but may possess an effective structure

Possible Description

The photon can be seen as:

- a propagation mode
- constrained by the geometry of the vacuum

Interpretation

This approach suggests that:

- the properties of the photon
  are not purely intrinsic
- they are linked to the structure
  of the medium in which it propagates

Conclusion

The photon may be understood
as a manifestation of the geometric structure
of the vacuum.

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15. Global Interpretation

General Observation

Across all sections,
the same elements reappear:

- ϕ
- π
- the number 12
- the pivot C

Interpretation

This recurrence suggests
that these constants are not independent.

Convergence of Results

The analysis reveals a convergence between:

- geometric constructions
- numerical results
- experimental observations

Key Point

These elements are not treated independently.

They are connected through the same framework.

Important Observation

Several results:

- are reproducible
- remain stable under variation
- appear in different contexts

Interpretation

This suggests that:

the observed structures
are not purely accidental.

16. General Conclusion

Summary of the Approach

This work has introduced a geometric framework
based on a discrete structure of 12 directions.

From this structure, a complex quantity T
has been defined and analytically reduced.

A normalized invariant C has been obtained
and used as a central element
throughout the analysis.

Main Results

Several domains have been explored:

- fine-structure constant
- proton and neutron masses
- numerical structures involving sequences of zeros
- speed of light
- gravitational behavior
- photon structure

Observations

Across these domains,
several recurring features have been identified:

- repeated use of the same constants
- emergence of structured numerical patterns
- convergence toward experimentally measured values

Interpretation

These observations suggest that:

the results are not purely random.

They indicate the possible presence
of an underlying structure.

Important Limitation

No complete theory has been established.

No exact derivation of all constants
has been achieved.

Position

This work should be considered as:

- a structured hypothesis
- a basis for further investigation

Interpretation

This coherence cannot be considered
as a proof.

However, it cannot be dismissed
as trivial coincidence.

Scientific Position

The most rigorous position is:

- the model is not validated
- but it is not invalidated

Implication

This defines a space of investigation
that remains open.

Final Conclusion

The hypothesis of a structured vacuum
based on a discrete geometric organization
may deserve deeper mathematical formulation
and experimental verification.

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